# Coherence. Reply to Gerard Vreeswijk

Kuipers, Theo A.F.

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**Theo A. F. Kuipers**

# COHERENCE

## REPLY TO GERARD VREESWIJK

In a way, Gerard Vreeswijk's contribution could better be seen as a contribution to a Volume in Debate with Paul Thagard, so a reply by Paul Thagard would be more interesting than one from me. In particular for Vreeswijk himself, I hope that Thagard will reply in some way or other. Be that as it may, I am pleased that the present volume stimulated Vreeswijk to design a new connectionist method that claims to evaluate theories in a way that improves on the method advocated by Thagard in terms of his theory of explanatory coherence (TEC), implemented in ECHO. Of course, the plausible question for me is whether Vreeswijk's version of TEC, which I will indicate by TEC-V, and his implementation in the program KNONET escapes the main criticisms that I raised in SiS against TEC/ECHO by comparing that combination with my simple principle of the Priority of Explanatory Coherence (PES), "implemented" by the even more simple comparative Evaluation Matrix (EM). In this reply I will first deal with this question, followed by some remarks about the prospects for the computational implementation of PES/EM.

### Comparing TEC/ECHO, TEC-V/KNONET, and PES/EM

Let me start by specifying Vreeswijk's opening paragraph which, incidentally, reflects his typical straightforward style of debate. In SiS I report (p. 313) that it took me forty-five minutes to calculate by hand two cases of theory comparison, indeed relatively very complicated ones, viz. Copernicus versus Ptolemy and Newton versus Descartes, by applying PES/EM on the two cases as propositionally structured by Nowak and Thagard (1992). As Vreeswijk wrongly suggests, I did not recalculate by hand their computational application of TEC/ECHO to these cases. It is all the more true that forty-five minutes is a long time, but since it indicates the time of a computation by (head and) hand, it nowadays means that an appropriate computer program might do it in a split second. Hence, what I did must be computationally very simple indeed.

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My points of criticism were in fact two related points. One, "ECHO-selection" is a non-transparent updating process (p. 306). Two, as long as you can achieve the same results in a much more simple way, you should prefer that way (p. 310). Of course, the claim that PES/EM is "much more simple" than TEC/ECHO should be judged on the basis of a hypothetical computer program implementing EM. My additional claim was that all historical examples of the products (not the processes) of theory selection reproduced by Thagard and his colleagues could be reproduced by PES/EM. My main worry about the non-transparency was that considerations of explanatory success and simplicity are intermingled by TEC/ECHO, whereas they are clearly separated in the PES/EM approach. In my reply to Thagard I make clear that I have in principle liberalized my separation claim, leaving room for weighted roles of (desired and undesired) empirical and nonempirical features. But first there should be a proof that it is needed. That is, the following challenge formulated in SiS (p. 313) should first be met:

> In general, the challenge of new cases is that they may lead to strong counter-examples of the claim that the EM-method reproduces the historical choices: the EM-method might prescribe the opposite choice. If there are such cases, our stratified model is descriptively inadequate, i.e., even with respect to the simulation of products.

It is highly questionable whether the only (appealing, hypothetical) example suggested to me by Thagard (see my reply to him) viz. the classical theory of air, earth, fire, and water, has really ever been found more successful, in a generalized, weighted sense, than the phlogiston theory or even the oxygen theory (after their conception, of course). Unfortunately, Vreeswijk does not provide such cases, either.

One of the main things Vreeswijk argues is that ECHO's crucial update formula (2) can better be replaced by the "gradient ascent" formula (5). Not, however, for reasons of greater clarity, but for reasons of greater computational speed. Moreover, although his direct connectionist coherence approach in Sections 4 and 5 certainly has some plausibility, in terms of the transparency of the resulting calculations it is obviously much less effective than PES/EM.

In sum, as long as there are no clear historical cases going against PES/EM, I take it that there is no need for indirect or direct coherence approaches to theory selection. However, I should concede that if such cases were to be produced, PES/EM is in trouble and the computational coherence approaches of Thagard and Vreeswijk may well be the proper answer.

## Implementing PES/EM and the Need for Justifying Normative Selection Algorithms

At the end of his paper Vreeswijk expresses the hope that somebody will implement PES/EM in order to compare it with TEC(-V). I am happy to relate that Alexander van den Bosch is far advanced with this project and is preparing a paper entitled "Explanatory coherence and the evaluation matrix." One important problem to overcome is that PES/EM, as it is formulated in SiS, compares just two theories, whereas TEC in fact compares all pairs of subsets of relevant propositions.

For the moment I would like to confine myself to stressing a point that Van den Bosch suggested to me about the paper by Vreeswijk. Although Vreeswijk is not very clear about this, it seems clear that he has only normative pretensions, in contrast to Thagard, who mainly has historical pretensions, not only regarding resulting selections, but also processes of selection. However – and this is Van den Bosch's basic point – in contrast to my PES/EM approach, which is rooted in the theory of empirical progress and truth approximation as developed in ICR, Vreeswijk still has to come up with some justification of his constraints, for otherwise you obtain an efficient but non-effective means, for the goal to be served is not specified. That is, one may concede that his constraints are very efficient, in the sense that they can easily be applied computationally. They may also be effective means to achieve some cognitive goal, but it is still not clear with respect to which goal they are effective. If such a goal could be identified, however, it would represent a convincing justification of Vreeswijk's constraints.

## REFERENCE

Nowak, G. and P. Thagard (1992). Copernicus, Ptolemy, and Explanatory Coherence. In: R. Giere (ed.), *Cognitive Models of Science*, pp. 274-309. Minneapolis: The University of Minnesota Press.